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Research Article

Artificial Intelligence Algorithms in Ice and Snow Tourism Promotion from Digital Technology

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The present work is aimed at using the artificial intelligence (AI) algorithm to study the promotion and publicity of ice and snow tourism (IST). Firstly, the urgent needs of IST external publicity are analyzed based on digital technology. Besides, the dynamic vision sensor technology is used to collect data in the distributed Internet of Things structure of the IST publicity system. Then, the AlexNet algorithm is combined with the digital logic method. The research assumption is that the complete IST image based on AI can be formed according to the AlexNet algorithm. The improved AlexNet algorithm and Chi-square test implement the IST poster emotion recognition and IST publicity model. Then, the intelligent customer service of the IST publicity platform is studied. The results demonstrate that after 120 iterations, the accuracy of the sports-oriented publicity method based on AlexNet can reach about 75%. In addition, the accuracy of the recommended IST publicity algorithm based on AlexNet is close to 90% after 80 iterations. Therefore, the model's accuracy is improved by at least 9.6% compared with the traditional method. The research has practical application value for the digital and intelligent development of the IST industry.

1. Introduction

China's economy is moving towards a new normal; correspondingly, tourism is developing towards industrial integration [1–3]. China's tourism industry is going through a critical transition with the government's support for the consumer industry. Thus, constructing a smart tourism city based on the Internet of Things (IoT) and cloud computing has become a brand new tourism promotion and publicity strategy in the new era. Compared with traditional publicity strategies, the tourism industry transformation driven by Internet technologies can satisfactorily respond to the urgent needs of economic globalization. Moreover, it is also essential for improving the international competitiveness of China's tourism industry.

The ice and snow tourism (IST) industry [4–6] has always been the focus of tourism development. It is one of the three critical industrial pillars for the future development of tourism. In the increasingly competitive IST market, image shaping is essential for tourist destinations. Only those tourist destinations with unique brand images and scientific management will stand out among many homogenized tourist products. Therefore, studying the IST city image [4, 7, 8] is crucial for tourism development.

Firstly, this study analyzes the urgent needs of IST publicity from the perspective of digital technology. Dynamic vision sensors (DVS) are used to collect data in the distributed IoT structure of the IST promotion system. Next, the AlexNet is integrated with the digital logic method to shape the IST image through artificial intelligence (AI). The main difficulty of the present research is that the accuracy of the traditional model for IST poster emotion recognition and publicity is not high. The main contribution is to build the emotion recognition and publicity effect model of the IST posters. The improved AlexNet algorithm and Chi-square test are innovatively used to study the customer service-oriented intelligent IST publicity model. The research results have a practical application value for the digital and technological development of the IST industry. In addition, the relevant research proves that the artificial neural network (ANN) algorithm has advantages in optimizing invasive weeds and the differential evolution model. For example, Movassagh et al. [9] studied the training algorithm of ANN and used an integrated algorithm to determine the

input coefficient of the neural network. Then, the authors compared this algorithm's performance with other algorithms such as ant colony and invasive Weed Optimization. The data results showed that compared with the existing algorithms, the proposed algorithm had higher convergence in neural network coefficients.

Based on AI algorithms and digital technology, the research on the publicity and promotion of IST can provide a reference for the digital and intelligent development of tourism publicity. The structural framework of the study is as follows. Section 1 introduces and explains the relevant background of the IST industry. Section 2 combs the recent research results of relevant tourism publicity strategies and the latest AI algorithms. Section 3 is the structure optimization of IST based on AlexNet. Section 4 expounds on the research results obtained by sorting out the experimental data. Section 5 draws the research conclusion through inductive analysis.

2. Recent Related Work

2.1. Research on Publicity Strategies Related to IST. The image promotion and shaping of tourist destinations is the key to improving the comprehensive competitiveness of tourist destinations in the increasingly fierce competition in the IST market. Scholars have researched the appropriate publicity strategies of the IST market. Ma and Cao [10] explored the economic process of the IST sustainable development in Heilongjiang Province, the relationship between the characteristics and advantages of IST, and the economic growth. The results showed that Heilongjiang IST had entered a new development stage. Tan et al. [11] took Changsha Ice and Snow World Water Park as the research object. The land quality around the quarry was improved through reclamation and reuse, which was crucial for the full use of land resources to promote tourism and culture. Du and Yu [5] used literature, field surveys, and other methods to analyze the development status of coastal sports tourism resources. They studied the development path of the coastal sports tourism (CST) industry from ecological protection. The results revealed that improving the resource protection system, integrating marketing strategies, and optimizing the industrial structure could help achieve reasonable resource development of CST. Sun [12] used Python to crawl online travel journals and reviews about IST in Jilin Province on the Internet and analyzed travel consumers' cognition and emotional attitude through AI. The results suggest that positive emotion expression accounts for 67.23% of the image perception of IST. Gao and Chang [13] proposed a suitable product plan based on the promotion of "IST" by the Chinese government through research on product planning and brand communication of ice and snow sports tourism in Arctic village, Mohe County. The results show that vigorously developing brand promotion can enhance the brand influence of Arctic Village. Zhai [14] expounded on the advantages of Heilongjiang Province's IST culture, which promoted the tourism culture through the translation research of Heilongjiang Province's ice and promotional materials for snow culture. Zhu et al. [15] summarized the deficiencies in the current research field of sports tourism in China by consulting literature and studying the relevant paths to develop the sports tourism industry from the experience economy. It is crucial for exploring the high-quality development path of the sports tourism industry. In short, the IST industry is a dynamic production and consumption system. With the upgrading of market consumption and the inclination of policy dividends, IST experience is becoming a new pillar of tourism industry development.

2.2. Research on Recent Algorithms of Digital Technology and AI. The rapid progress of digital technology and AI algorithms provides a brand new intelligent development path for image shaping and IST destination promotion. Brock and Wangenheim [16] used the research on the relationship between digital transformation leaders and AI-based case studies and the results of two global surveys for senior managers across industries. AI was used in conjunction with other advanced digital technologies in the company's digital transformation projects. Lutz [17] studied the digital imbalance technology in the era of AI and big data by focusing on labor and significant data issues. The results showed that interaction between individuals and emerging technologies would make social life more convenient with ubiquitous data mining, analysis, and AI. Ågerfalk [18] studied the technology of AI as a digital agent. The results indicated that the information system conceptualization-related AI could increase the exchange and interaction of social information. Mogaji et al. [19] discussed AI, digital marketing, and financial services related to disadvantaged customers and research on the impact of AI on digital marketing of financial services for underprivileged customers. They emphasized the importance of interpersonal relationships for the best customer experience and interaction with financial service providers. Li et al. [20] used digital innovation-supported telemedicine and AI to adapt to new nursing models. These studies have fully considered the vast challenges of clinical implementation and feasibility suggestions for future directions. They have practical application value for medical service technology's systematic and intelligent development.

In summary, following a literature review on the already mature digital technology and AI applications in industrial fields, this study studies IST publicity and promotion. The research has a theoretical reference value and practical consequences for the intelligent industrialization of IST using AI neural network algorithms. Lyu and Liu [21] studied AI and emerging digital technologies in the energy field and explored the energy innovation direction based on IoT, robotics, and blockchain technology. The results corroborated that the contribution of AI to the performance of energy companies was gradually improving. Energy companies should inject high requirements for new talents' AI-related technical skills. Leone et al. [22] conducted a case study on the healthcare ecosystem to explore how AI realized and enhanced the value of the industrial market. They proposed an integration framework with two iterative cycles. The numerical results indicated that healthcare organizations were making extensive use of AI technology for

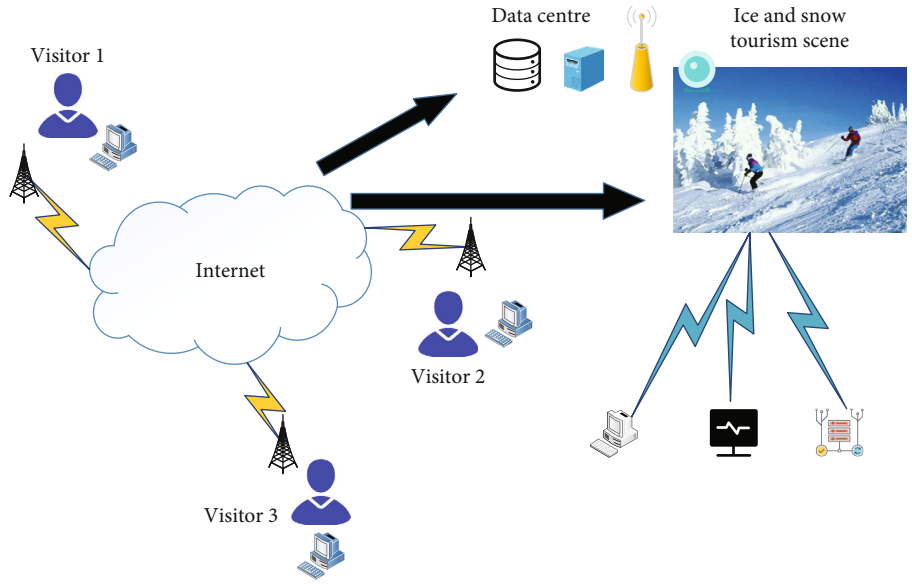

Figure 1: System architecture of the distributed IoT IST publicity system.

organizational optimization. Matthews et al. [23] studied the weather index driven by the tourism development data of beach parks. They evaluated the design of the tourism climate index and holiday climate index beach. The results showed that the weather would affect the number of beach visitors and help tourism marketers and managers make decisions. Babu et al. [24] studied the secure data aggregation method in wireless sensor networks and proposed an adaptive source location privacy protection technology using random routing. The packet delivery rate of the proposed method was 20% higher than the existing methods, and the packet loss rate of the system was reduced by 15%. Alzubi et al. [25] used a deep neural network to integrate and study depth image subtitles. The researchers employed a user-defined integration model composed of an inception model and a two-layer long short-term memory (LSTM) model. They also added a task corpus that could be realized by the deep learning model, which had practical reference value for applying the deep learning model.

3. Intelligent Customer-Service-Oriented IST Publicity Platform Based on IoT

3.1. Demand Analysis and Construction of Customer-Service-Oriented IST Publicity Platform. Constructing a smart tourism city based on information technologies, such as the IoT and cloud computing, has become a new development trend in the tourism industry. It is based on IST industrial integration [26] and strategic upgrading and transformation. The latest IST publicity platform will provide tourists with structured and integrated urban tourism information and increase resource sharing and utilization.

An intelligent sensor is adopted to reduce data redundancy and delay by capturing the real-time situation of tourists. Additionally, intelligent sensor interaction technology is used to collect information in time. Then, the data collection system manages the information and forwards it to the data processing terminal. The IoT platform is used for digitizing all tourist attractions information. Finally, the intelligent tourism service-oriented IST publicity platform is reconstructed in cyberspace. The center of the proposed IST publicity platform integrates the physical dimension and the digital strategy. Therefore, the physical and digital systems coexist and merge in the information dimension. The system can provide tourists with a real-time passenger flow of various attractions. It can also monitor multiple indexes of tourism destinations, such as the weather. Figure 1 displays the architecture of the distributed IoT IST publicity platform using DVS for data collection:

In traditional neural networks, training sets differ significantly as per target tasks. For example, ImageNet sets based on natural image distribution are often used for training models to recognize animals and realistic scenes. Larger-than-threshold weight will incur poor fitting. Therefore, it is necessary to deal with data adaptability and establish an emotion recognition model for large-scale datasets. The proposed intelligent IST publicity model based on the deep learning algorithm and the Internet can analyze the emotional semantics of tourists based on bottom visual feature recognition. In the case of insufficient sample data, the model can solve the overfitting problem of transfer learning to improve the deep learning network.

3.2. The Image Shaping and Digital Logic Method of IST Promotion. In the publicity strategy of IST activities, tourism publicity, as an easy-to-understand way, can evaluate the scenery of the scenic spot from artistic conception and charm. The publicity strategy will be adjusted according to the feelings and attitudes of tourists to improve the effect of tourism publicity and promotion. Besides, emotion visualization can show the digital law of emotion behind the poster. It expands the impact of the model on tourist choice. The convolutional neural network [27] (CNN), recursive

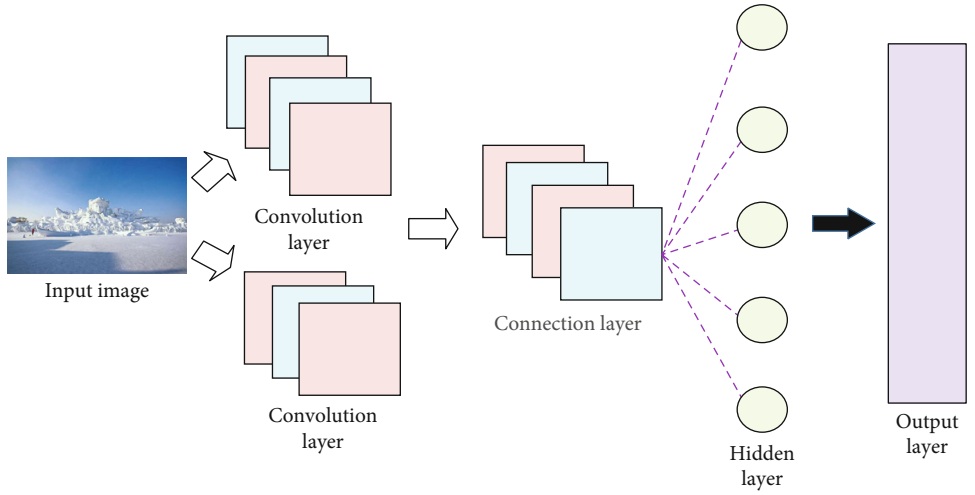

Figure 2: The flow chart of CNN model processing and identification of IST posters.

neural network [28] (RNN), and LSTM [29] are standard image recognition algorithms. CNN is a feedforward neural network with different layers, such as convolution, fully connected, and pooling layers. It is used for emotion recognition in the current work. Figure 2 shows the process of CNN processing and identifying IST posters.

In the model training of the algorithm network, Newton's method is used to update the parameters. For the gradient descent algorithm, the minimum loss function of a single training sample is expressed as

$$J(W, b; x, y) = \frac{1}{2h_{W,b}(x) - y^2}, \tag{1}$$

where (x, y) represents a single training sample. W and b represent the weight and error of the matrix. Equation (2) calculates the loss function of the overall training set.

$$J(W, b) = \left[\frac{1}{m}\sum_{i=1}^{m} J\left(W, b; x^{(i)}, y^{(i)}\right)\right] + \frac{\lambda}{2}\sum_{l=1}^{n_t-1}\sum_{i=1}^{s_t}\sum_{j=1}^{s_{t+1}}\left(W_{ji}^{(l)}\right)^2. \tag{2}$$

In Equation (2), $[(1/m)\sum_{i=1}^{m} J(W, b; x^{(i)}, y^{(i)})]$ represents the standard deviation, $(\lambda/2)\sum_{l=1}^{n_t-1}\sum_{i=1}^{s_t}\sum_{j=1}^{s_{t+1}}(W_{ji}^{(l)})^2$ represents the weight attenuation term, and $W_{ji}^{(l)}$ represents the weight coefficient of the regularization term. Equations (3) and (4) are the parameter updating process in the gradient descent process of the function:

$$W_{ij}^{(l)} = W_{ij}^{(l)} - \alpha\frac{\partial}{\partial W_{ij}^{(l)}} J(W), \tag{3}$$

$$b_i^{(l)} = b_i^{(l)} - \alpha\frac{\partial}{\partial b_i^{(l)}} J(W, b), \tag{4}$$

where W and b represent the weight and error of the matrix, α represents the gradient descent step, and the weight attenuation process of the loss function needs to be recalculated.

3.3. Smart Service Mode of IST Publicity Using AlexNet Algorithm. Through the improved AlexNet and Chi-square test, the multimodal poster emotion recognition and publicity effect model are designed. Based on the LeNet, the improved AlexNet model deepens the structural level, learns rich high-dimensional image features, and uses the stacking form of convolution layer+pooling layer to extract the image features. The present work selects AlexNet because of its deeper structure and more critical learning ability than other neural system models. The improvement of the AlexNet model can bridge the semantic gap of identifying tourism emotion from abstract images (such as tourism posters). Thus, the AlexNet algorithm solves many problems, saves the computational cost, and improves the accuracy of customer emotion recognition. Figure 3 gives the model recognition process.

In the process of backpropagation, the calculation of the weight attenuation process of the loss function is as follows:

$$\frac{\partial}{\partial W_{ij}^{(l)}} J(W, b) = \left[\frac{1}{m}\sum_{i=1}^{m}\frac{\partial}{\partial W_{ij}^{(l)}} J\left(W, b; x^{(i)}, y^{(i)}\right)\right] + \lambda W_{ij}^{(l)}, \tag{5}$$

where W and b represent the weight and error term of the matrix and $(x^{(i)}, y^{(i)})$ represents the estimated parameters of the model. The calculation error of the output layer in each output unit is different. Equations (6) and (7) display the calculation:

$$\delta_i^{(n_t)} = \frac{\partial}{\partial z_i^{n_t}} J(W, b; x, y) = \frac{\partial}{\partial z_i^{n_t}}\frac{1}{2}y - h_{W,b}(x)^2, \tag{6}$$

$$\delta_i^{(l)} = \left(\sum_{j=1}^{S_{t+1}} W_{ji}^{(l)}\delta_j^{l+1}\right) f'\left(z_i^{(l)}\right), \tag{7}$$

where $\delta_i^{(n_t)}$ represents the calculation error of the output

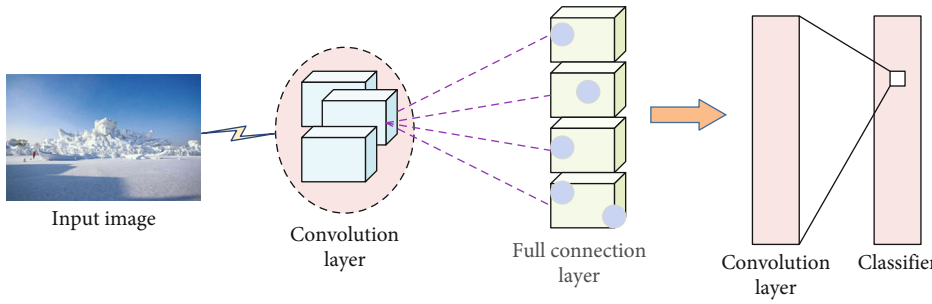

Figure 3: The flow chart of the emotional recognition and publicity effect model of posters by the improved AlexNet and Chi-square test.

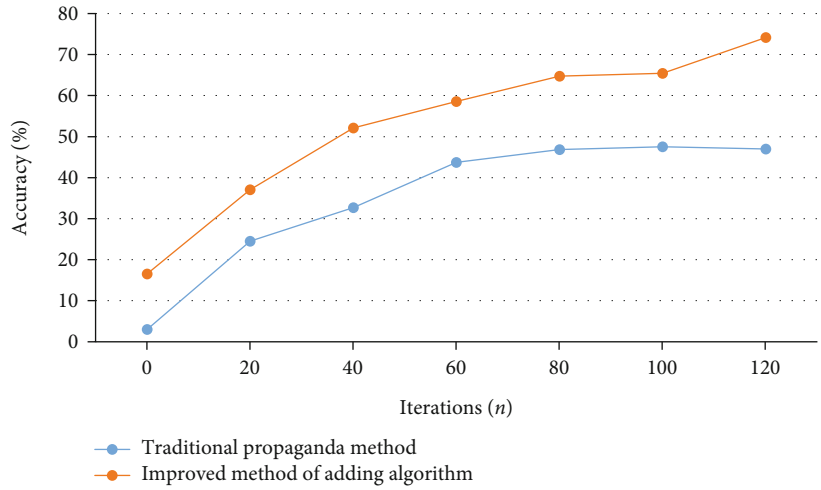

Figure 4: Performance curve of the proposed AlexNet-based IST publicity algorithm and the traditional algorithms in scenic spot recommendation.

unit, $z_i^{(l)}$ represents the hidden layer, and $\partial/\partial z_i^{n_t}$ represents the partial derivative of the hidden layer. Sample data labels are classified. A mature parameter model is obtained after the loss function converges.

3.4. Case Analysis and Performance Evaluation. The performance of the model algorithm is verified and evaluated on MATLAB. The case study is based on Harbin in Heilongjiang Province. The experimental dataset is grouped into a training dataset and testing dataset by 8 : 2. The training dataset is used for model adjustment and deep learning feature extraction. The testing set is used for model performance verification. Data types are evenly distributed in the two datasets. The IST publicity platform mainly includes the information processing, service, and consumption entrance layers. The platform communicates and interacts through wireless communication, virtual reality (VR), and radiofrequency identification (RFID) technology. The proposed platform's working radiofrequency (RF) is 902 MHz~928 MHz. The experimental simulation is carried out by installing the universal serial bus (USB) to the serial port driver and read/write controller on the computer. Additionally, to evaluate the application effect of the IST publicity model, an improved AlexNet algorithm is proposed to recommend IST attractions. Then, the improved AlexNet is compared with the traditional IST publicity strategies from the aspects of the effectiveness of scenic spot recommendation and the effect of promotion and application. Lastly, the model training error and training time are comparatively analyzed.

4. Results

4.1. Analysis of Algorithm Publicity Application Results. The proposed improved-AlexNet-based IST publicity method is compared with the traditional approaches, as in Figures 4–7.

In Figure 4, the proposed AlexNet-based IST publicity algorithm performs better in the accuracy of scenic spot recommendations than traditional publicity methods. The accuracy of the conventional publicity method of scenic spot recommendation can only be maintained at about 50% after 100 iterations. However, the publicity method improved by the AlexNet algorithm has room for accuracy improvement. After 120 iterations, the AlexNet-based IST publicity algorithm reaches a 75% accuracy for scenic spots recommendation. It dramatically improves the fitness between the system-recommended scenic locations and the tourist needs.

With the addition of the AlexNet algorithm in Figure 5, the improved publicity method has a higher accuracy of recommended scenic spots than the traditional method. After 80 iterations of the model experiment, the accuracy of the traditional publicity method can only reach about 50%. Still,

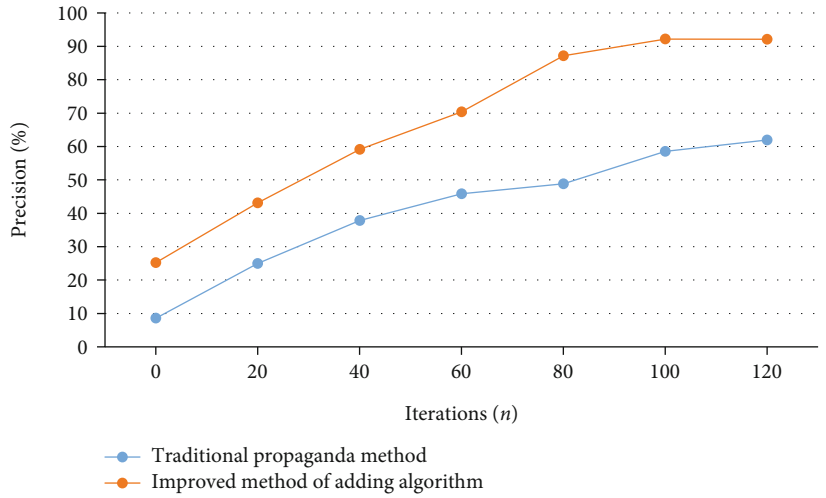

Figure 5: Performance change curve of the AlexNet-based IST publicity method and the traditional manner in scenic spot recommendation.

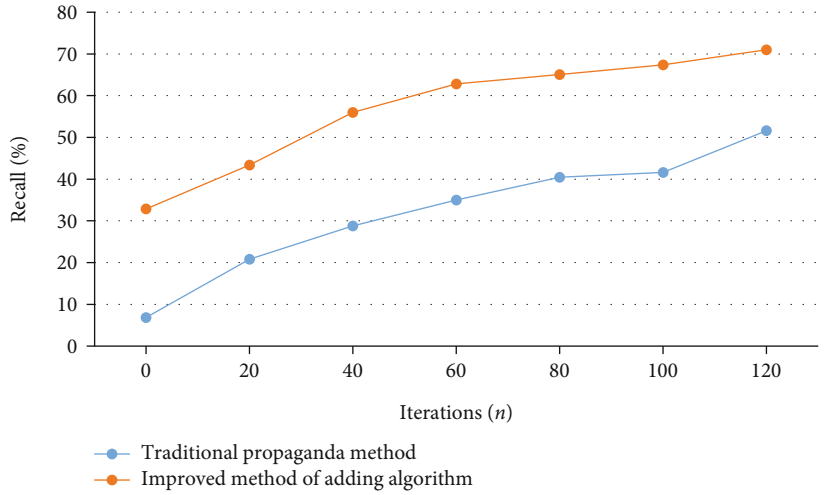

Figure 6: The performance curve of AlexNet-based IST publicity method and the traditional manner in the recall rate of recommended attractions.

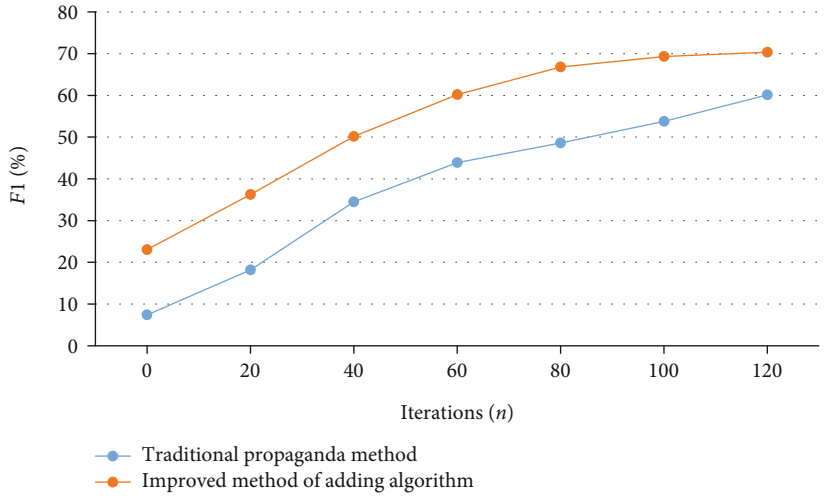

Figure 7: The performance curve of AlexNet-based IST publicity method and the traditional manner on the $F1$ value of the recommended scenic spot.

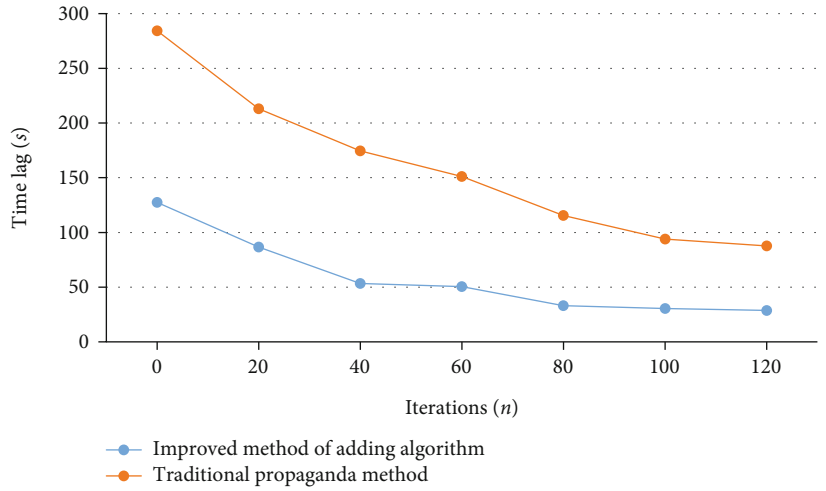

Figure 8: The delay error curve of different IST publicity methods on the training dataset.

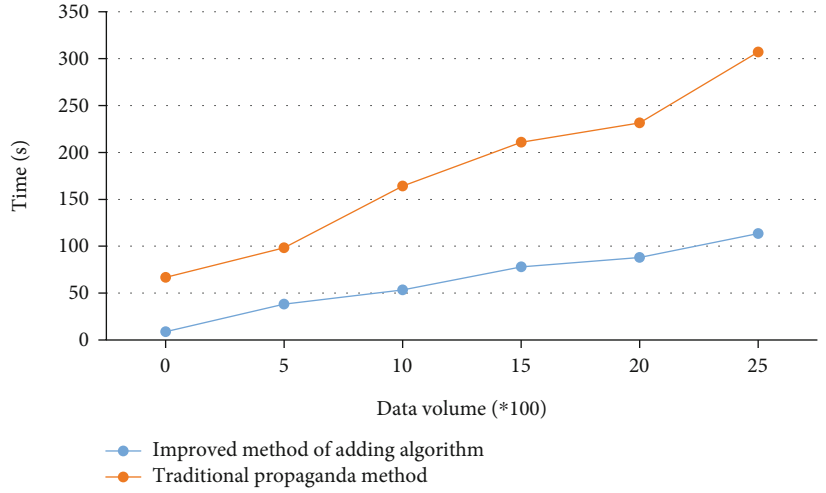

Figure 9: The time curve of the model of different IST publicity methods under other data volumes.

the accuracy of the publicity method with an improved algorithm is close to 90%. Overall, compared with the traditional recommended attractions model, the system model with an enhanced algorithm has improved the accuracy of recommended scenic spots by at least 9.6%.

In Figure 6, the recall rate of recommended scenic spots in the traditional publicity method and the publicity method with the algorithm improvements shows an upward trend with the increase in model iterations. The AlexNet-based IST publicity algorithm performs better than traditional publicity methods. After 60 iterations, the recall rate of the AlexNet-based IST publicity algorithm reaches more than 60%. It dramatically improves the reliability of system tourism promotion and scenic spot recommendations.

Figure 7 reveals that as iteration increases, the $F1$ value of recommended scenic spots of the traditional publicity methods and AlexNet-based IST publicity method shows an upward trend. The AlexNet-based IST publicity method outperforms traditional publicity methods. After 120 iterations, the $F1$ value of the AlexNet-based IST publicity method has reached about 70%, at least 8.7% higher than the traditional methods. It dramatically enhances the reliability and stability of the algorithm model.

4.2. Comparison of Model Training Error and Training Time Performance. The proposed AlexNet-based IST publicity algorithm's variation curve of delay error is compared with that of the traditional publicity method, as in Figure 8. Additionally, the time and speedup required for the proposed algorithm model are compared with conventional publicity methods, as presented in Figures 9 and 10.

In Figure 8, the proposed AlexNet-based IST publicity outmatches traditional publicity methods. After 60 iterations, the data transmission delay of the conventional publicity strategy reaches 150 s. The transmission delay of the proposed AlexNet-based IST publicity is only about 50 s, dramatically reducing tourists' waiting time.

In Figure 9, as data volume increases, the time required for the traditional IST promotion strategy and the proposed AlexNet-based IST publicity algorithm is gradually growing. The proposed AlexNet-based IST publicity algorithm is less sensitive to data volume increase than the conventional

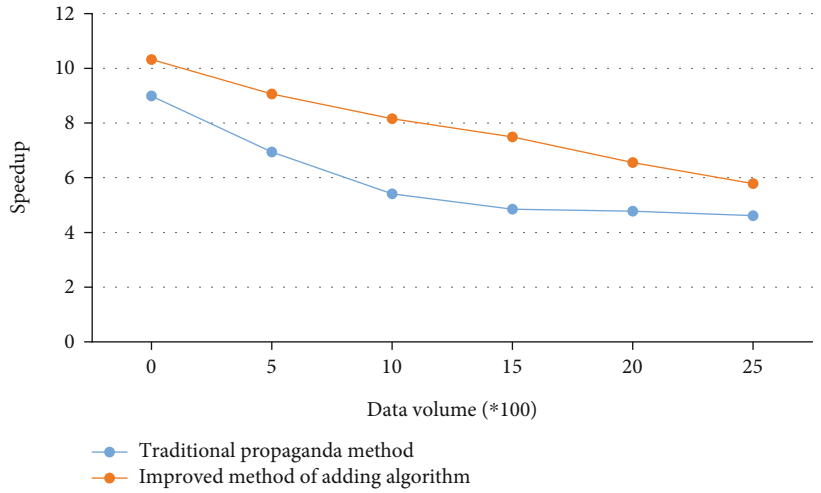

Figure 10: Speedup curve of different IST publicity methods under other data volumes.

strategy. For example, given a 2,000 data volume, the time cost of the proposed AlexNet-based IST publicity algorithm can be kept below 100 s, much lower than 220 s of the traditional strategy. Thus, the proposed AlexNet-based IST publicity algorithm has dramatically improved the efficiency of tourist attractions promotion.

In Figure 10, the speedup of the traditional IST promotion strategy and the proposed AlexNet-based IST publicity algorithm gradually decreases as the data volume increases. The speedup of the proposed AlexNet-based IST publicity algorithm is more gradual than the traditional publicity method. Thus, the proposed IST publicity algorithm has better performance. For example, given a data volume of 1,500, the conventional strategy's speedup is five compared to eight of the proposed IST publicity algorithm. Therefore, the proposed AlexNet-based IST publicity algorithm dramatically improves publicity and promotion efficiency compared to traditional models.

5. Conclusion

With the economic development entering the transition period, IST has gradually become the core of China's winter tourism. This paper combines AlexNet and the digital logic method to shape the promotion image of IST. The model scheme of emotional recognition and publicity effect of IST posters is established based on the improved AlexNet algorithm and Chi-square test. Then, the IST publicity algorithm based on AlexNet is tested in intelligent customer service. The results indicate that compared with the traditional methods, the IST publicity algorithm based on AlexNet has higher accuracy of scenic spot recommendation. For example, after 120 iterations, the scenic spot recommendation accuracy of the IST publicity algorithm based on AlexNet attains about 75%. In addition, after 80 iterations, the recommendation accuracy of the IST publishing method is nearly 90%, at least 9.6% higher than that of the traditional way. This is of great significance to enhance the publicity effect of tourIST attractions. However, some research defects have not been avoided in the current work. The primary deficiency is that this IST publicity research focuses on famous scenic spots in China while ignoring publicity strategies of favorite IST scenic spots abroad. Meanwhile, there is insufficient data in foreign intelligent tourist attractions, so it is impossible to carry out the relevant experimental simulation. Therefore, the follow-up research will further strengthen the data mining of Intelligent Tourism Service and optimize the service pattern.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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